

-continued

	Dimension (in)
Overall width	0.180
Overall Height	0.049
Overall length	1.500

[0131] An Al_2O_3 slurry is prepared by mixing 7.2 g of gamma Al_2O_3 powder, 12 g of deionized H_2O and 42 g Al_2O_3 beads with 3 mm diameter. The pH value is adjusted to 3.5-4 using nitric acid. The Al_2O_3 is acidic gamma Al_2O_3 which is ground to powder smaller than 150 micrometers. The mixture is ball-milled for 8 hours. 0.8 g of 25 wt. % Al_2O_3 sol (Sasol 14N4-25) is added to 4.2 g of the slurry with stirring.

[0132] The FeCrAlY fin is cleaned in iso-propanol for 20 min with sonication. After drying at 100° C. for 1 h and cooling to room temperature, the fin is cleaned in 20 wt. % HNO_3 solution for 20 min with sonication. The fin is then rinsed with deionized water until the pH value is 7. After drying at 120° C. for 1 hour, the fin is heated to 1000° C. in air at a heating rate of 3.5° C./min and calcined at 1000° C. for 8 hours in air. A dense Al_2O_3 layer is generated after the calcination. The Al_2O_3 layer functions as a protection scale and also improves the adhesion between the coating and the fin. The Al_2O_3 slurry is washcoated onto the fin by dipping. The excess slurry is removed by jetting air over the coated surface. The fin is dried at 1200° C. for 1 hour and then calcined at 450° C. for 4 hours at a heating and cooling rate of 3.5° C./min. A 7.5 wt. % $\text{La}(\text{NO}_3)_3$ solution is impregnated onto the fin by dipping. The fin is dried at 120° C. for 1 hour and then calcined at 1000° C. for 4 hours in air at a heating and cooling rate of 3.5° C./min. The La_2O_3 on the surface stabilizes the Al_2O_3 . The slurry loading is 25.4 mg per fin. A 10 wt. % $\text{Rh}(\text{NO}_3)_3$ solution is dropped onto the fin and the excess solution is blown out by compressed air. The resulting fin supported catalyst is dried at 120° C. for 1 hour and then calcined at 1000° C. for 1 h in air. The Rh loading is 4.8 mg per fin.

[0133] The fin supported catalyst is tested for partial oxidation of methane to syngas at 1 atmosphere in a pellet. The pellet is a cylindrical metal rod having a diameter of 0.5 inch and a length of 2 inches. The pellet has a rectangular microchannel cut-away in its center. The cut-away extends through the rod along its interior axis. The cut-away has a height of 0.05 inch and a width of 0.18 inch. The fin supported catalyst is placed in the cut-away for testing. Gas tight connections are made on each side of the cut-away. The reactants flow through tubing to the cut-away, and through the cut-away in contact with the fin supported catalyst. The pellet is placed in a furnace. The temperature of the furnace is increased to keep the pellet outside skin temperature at mid-length at 850° C. The temperature of the feed stream at the inlet of the furnace is at room temperature and is preheated before entering the pellet. The length of the tubing from the entrance of the furnace to the pellet is 10 feet. The outlet pressure of the product stream is atmospheric pressure. The pressure drop in the pellet is measured using a Capsuhelic differential pressure gauge. The composition of the product is analyzed with a two-column Gas Chromatograph. The performance of the fin supported catalyst is measured in terms of CH_4 conversion, H_2 selectivity and CO selectivity.

$$\text{CH}_4 \text{ Conversion } (\%) = (\text{V}_{\text{CH}_4, \text{ in}} - \text{V}_{\text{CH}_4, \text{ out}}) / (\text{V}_{\text{CH}_4, \text{ in}}) \times 100$$

$$\text{H}_2 \text{ Selectivity } (\%) = (\text{V}_{\text{H}_2, \text{ out, actual}}) / (\text{V}_{\text{H}_2, \text{ out, theoretical}}) \times 100$$

$$\text{CO Selectivity } (\%) = (\text{V}_{\text{CO, out}}) / (\text{V}_{\text{CO, out}} + \text{V}_{\text{CO}_2, \text{ out}}) \times 100$$

[0134] The catalyst is reduced with H_2 at 400° C. for 30 min before use. The feed gas compositions are 29.6% of CH_4 and 70.4% of air ($\text{CH}_4/\text{O}_2=2/1$), with 2030 ml/min of total flow rate (standard conditions). The contact time is 3.3 ms. The contact time is defined as the ratio of flow volume in the pellet without the fin to the volumetric flow rate. The following table summarizes the fin supported catalyst performance after 157 hours of operation.

Parameter	Value
Coating Type	Powder slurry wash-coat
Fuel composition	29.6% CH_4 , 70.4% air
Fuel contact time	3.3 ms
CH_4 Conversion (at 850° C.)	85%
H_2 Selectivity (at 850° C.)	92%
CO Selectivity (at 850° C.)	95%
Pressure drop	5.6 psi

EXAMPLE 3

[0135] An alternate fin for use in a POX reaction process provides the advantage of reduced pressure drop. The flow area is increased by reducing number of fins. There are five fins projecting up from the fin support. The fins have a trapezoidal cross section as indicated in FIG. 6. The thickness of the fin along with trapezoidal shape of the fins provides mechanical rigidity at the base of the fins. The fins are supported on rectangular support or base to enhance heat transfer characteristics of the fin. The fin is made from FeCrAlY. The fin is fabricated by the wire EDM method. The following table summarizes dimensions of the fin:

	Dimension (in)
<u>Fin Thickness</u>	
At base	0.020"
At top	0.010"
<u>Fin spacing</u>	
At base	0.012"
At top	0.022"
Fin height	0.033"
Rectangular base height	0.020"
Overall width	0.180"
Overall height	0.053"
Overall length	1.500"

[0136] An Al_2O_3 slurry is prepared by mixing 7.2 g of gamma Al_2O_3 powder, 12 g of deionized H_2O and 42 g Al_2O_3 beads with 3 mm diameter. The pH value is adjusted to 3.5-4 using nitric acid. The Al_2O_3 is acidic gamma Al_2O_3 and is ground to powder smaller than 150 micrometers. The mixture is then ball-milled for 8 hours. 0.8 g of 25 wt. % Al_2O_3 sol (Sasol 14N4-25) is added to 4.2 g of the slurry with stirring.

[0137] The FeCrAlY fin is cleaned in iso-propanol for 20 min with sonication. After drying at 100° C. for 1 hour and